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(54) **MOISTURE SUPPLY APPARATUS.**

(57) Moisture supply apparatus and associated method for supplying moisture to the interior of a refrigerated display cabinet (20), the apparatus comprising a source of moisture, such as a fog generator (4), means for delivery moisture from the source to the refrigerated area (20) including a fan, ducting (5) and a moisture d livery system, such as a moisture distribution tube (6) and/or nozzles (7), wherein the apparatus further comprises a source of ozone (9) and means arranged to subject substantially the whole of the interior of the components (3 to 7) of the apparatus to ozone at a bacteriacidal level from the ozone source.

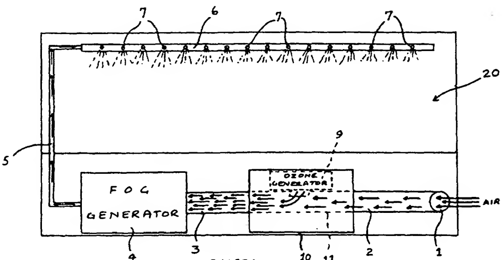

FIGURE 1

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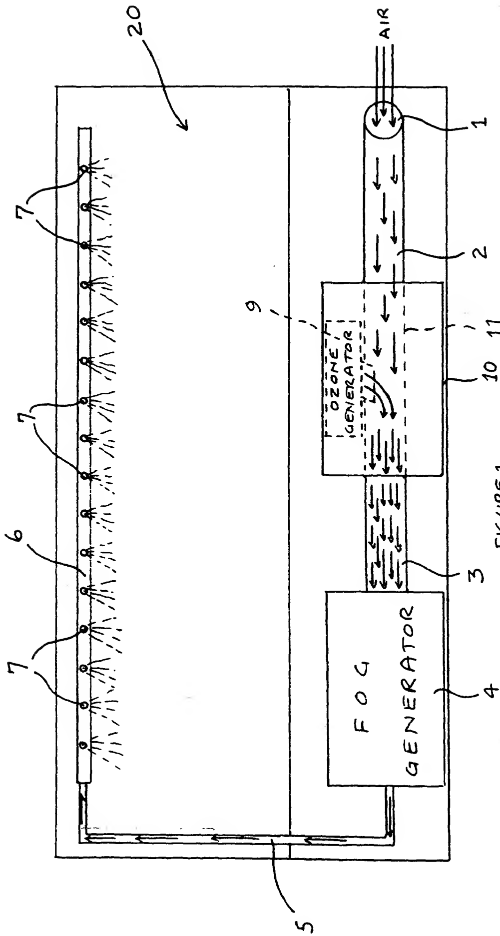

FIGURE 1

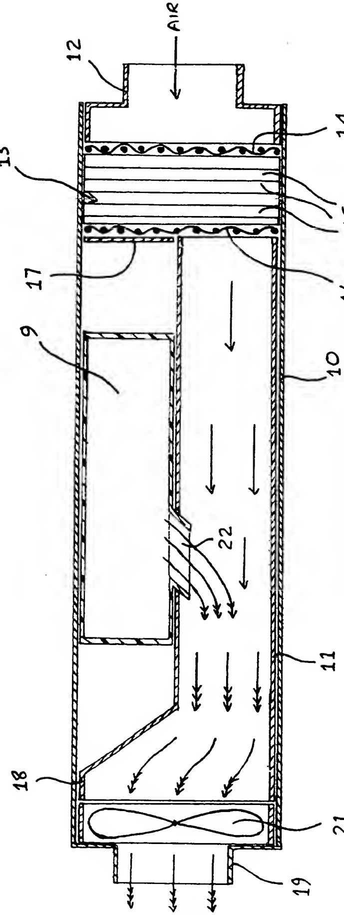

FIGURE 2

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MOISTURE SUPPLY APPARATUS AND METHOD

DESCRIPTION

This invention relates to apparatus for supplying moisture to, say, the interior of a refrigerated display cabinet, storeroom or other refrigerated area containing, for example, food products, such as fresh or cooked meats, fish and/or delicatessen products, fresh flowers, fruit and/or vegetables, whose water content, surface appearance and/or other moisture-dependent property(ies) is/are to be maintained at a desired level by keeping the atmospheric moisture content within such refrigerated areas at a given level.

Such moisture supply apparatus can deliver the moisture to a refrigerated area in any desired form, for example, as water vapour or water droplets, as a fog, as humidified or moisturised air, as any other form of moisture-containing air or as any combination thereof, depending upon the particular application of the apparatus. However, throughout this specification the word "moisture" is used to embrace moisture in any form, whether it be mixed with air or not.

Typically, moisture supply apparatus of known type comprises a source of moisture, such as a fog generator, means for delivering moisture from the source to the refrigerated area including a fan, ducting and a moisture delivery system, such as a moisture distribution tube and/or nozzles, for delivering moisture directly into the refrigerated area. Thus, throughout this specification the term "moisture supply apparatus" is used to embrace

apparatus comprising, inter alia, at least a source of moisture and moisture delivery means, such as that described above.

These known types of moisture supply apparatus, sometimes known as "moisture maintenance systems", are designed to counteract the drying effect of refrigeration on fresh or cooked food products in retail display cabinets or in refrigerated storage by delivering moisture to the atmosphere within such refrigerated areas. In this manner, the so-delivered moisture substantially counteracts the drying effect of the refrigeration upon the products but, nevertheless, enhances conditions for promoting the growth of not only bacteria but also fungus, mould, spores, algae and various yeasts within the components of the moisture supply apparatus and, ultimately, within the refrigerated display cabinets or storage areas themselves. Throughout this specification, the word "bacteria", as well as its derivatives, is used to embrace not only bacteria <u>per se</u> but also any fungus, mould, yeast, spores, algae and/or any other contaminants which can enter and/or multiply within the interior of the components of the moisture supply apparatus.

Any air extracted from either ambient air or the refrigerated air being circulated within the refrigerated display cabinets or refrigerated storage, can contain at least some bacteria capable of contaminating the components of the moisture supply apparatus where it can multiply and be transmitted subsequently on to the products within the refrigerated display cabinets or storage.

Thus, once bacteria have entered the moisture supply apparatus, their multiplication within the various components of the apparatus and subsequent transmission into the refrigerated display or storage area, creates undesirable and unhygienic conditions. Pathogenic or other dangerous bacteria, which can also enter the apparatus through an associated water supply for, say, a fog generator, are also capable of multiplying and infecting not only the components of the apparatus but also the atmosphere, and eventually the products, within the refrigerated display or storage area.

The management of bacteria within these known types of moisture supply apparatus, for example, within fogging or humidification systems, is essential for the maintenance of good hygiene. Previously, some parts, such as the moisture distribution tube and/or ducting adjacent the moisture delivery nozzles, of the apparatus has been fitted with bacteriacidal means, such as, ultraviolet lamps, for the localised killing of bacteria. Such ultraviolet lamps have been used to generate ultraviolet radiation and/or small amounts of ozone which are bacteriacidal but employed on a very localised basis. However, it has not been possible to render effective the bacteriacidal effect throughout substantially all the components of the moisture supply apparatus.

Similarly, comparatively small amounts of ozone have been bubbled through the water in moisture generators, such as fog generators employing ultrasonic transducers, but the ozone has been ~~absorbed~~ and/or adsorbed by the so-generated droplets of moisture and, thus, has not been able to come into

substantial contact with the interior surfaces of the components of the moisture supply apparatus.

Thus, again it has not been possible to put into full effect the bacteriacidal properties of ozone throughout substantially all of the components of the moisture supply apparatus.

Thus, it is an object of the present invention to provide moisture supply apparatus, and an associated method, which overcomes, or at least substantially reduces, the disadvantages of known types of such apparatus, as described and discussed above.

Accordingly, a first aspect of the invention resides in moisture supply apparatus as hereinbefore defined, further comprising a source of ozone and means arranged to subject substantially the whole of the interior of the components of the apparatus to ozone at a bacteriacidal level from the ozone source.

The source of ozone may take any suitable form. For example, it may be a port(s) provided in ducting and/or other appropriate component(s) of the apparatus and connected or connectable to, say, an ozone generator remote or otherwise exterior of the ducting or other components of the apparatus. In a preferred embodiment of the inventive apparatus, however, an ozone generator, as a source of ozone, is incorporated within other components of the apparatus, preferably upstream of the source of moisture, such as, a fog generator, of the apparatus.

Also, the so-generated bacteriacidal level of ozone may be mixed or otherwise combined with the

moisture downstream of, and preferably immediately downstream of and more preferably adjacent, the source of moisture, for example a reservoir of water from which the moisture can be generated, rather than being bubbled through the water reservoir, as in the case of prior art arrangements. It has been found that combining the ozone directly with the water droplets of the moisture provides more efficient absorption and/or adsorption of ozone in the water droplets and, thus, a more efficient and effective method of killing any bacteria therein.

The source of ozone may be operated intermittently for predetermined time periods with or without the moisture source operative, as will be discussed in more detail below.

A second aspect of the invention resides in a method of bacteriacidally treating moisture supply apparatus as hereinbefore defined, comprising subjecting substantially the whole of the interior of the components of the apparatus to a bacteriacidal level of ozone.

Preferably, the ozone source is arranged to maintain within the interior of the components of the apparatus a bacteriacidal ozone level of, say, approximately 1.5 to 2.5 parts per million in air for a period of time sufficient to kill substantially all, but at least a major proportion of, the bacteria, as well as any mould, fungus, yeast or spores, whilst preferably maintaining an ozone level of no more than 0.3 parts per million in air in the interior of a refrigerated display cabinet, refrigerated storage area or other refrigerated area associated with the

apparatus and preferably no more than 0.1 parts per million adjacent the exterior thereof.

Health and safety regulations (Health and Safety Executive Note EH 38 (Revised) Ozone: Health and Precautionary Measures) set an occupational exposure level for ozone of 0.2 parts per million in air averaged over 15 minutes. In order to meet these requirements, the apparatus and method may be arranged to operate the source of ozone continuously or periodically outside normal trading or working hours during which a person might otherwise be exposed to ozone levels greater than such specified by those health and safety regulations. Alternatively or additionally, the ozone source may be operated during such normal trading or working hours but so that the ozone level in the refrigerated area with which the apparatus is associated, does not exceed that stipulated by the health and safety regulations, for example, an ozone level of no more than 0.2 parts per million in air averaged over 15 minutes.

It has been found that when the ozone source is operative and the moisture source is inoperative, namely when the apparatus is operating in its so-called "purging" or "deep cleansing" mode and when comparatively low moisture levels are present in the components of the apparatus, the bacteriacidal kill rate is generally much greater, at least insofar as the interior surfaces of the apparatus components are concerned, than when both the ozone and moisture sources are operative, namely, when the apparatus is operating in its so-called "atmospheric" mode and when comparatively high moisture levels are present in the atmosphere within the apparatus components. It is

thought that the reason for this phenomenon is that when the apparatus is operating in its atmospheric mode, some, and probable a high proportion, of the ozone is adsorbed and/or absorbed by the water droplets or vapour of the moisture being delivered to the moisture delivery system from the moisture source and, thus, the amount of ozone available for killing bacteria on the interior surfaces of the components of the apparatus is reduced.

Thus, in the context of this specification, the word "purging" or "cleansing" is used in relation to the bacteriacidal effect of ozone upon substantially the whole of the surfaces of the internal walls of the components of the apparatus, such components comprising, inter alia, the moisture source, the moisture delivery means and any associated ducting, when the apparatus is in that operational mode, whilst the word "atmospheric" is used in relation to the bacteriacidal effect of ozone upon the water droplets of the airborne moisture, and to a certain extent the air, in the atmosphere within those apparatus components when the apparatus is in that other operational mode.

In accordance with a third aspect of the invention, there is provided a method of bacteriacidally treating airborne moisture, which method comprises mixing or otherwise combining a bacteriacidal level of ozone directly with the airborne moisture.

In accordance with a fourth aspect of the invention, there is provided apparatus for generating bacteriacidally-treated airborne moisture, such as

moisture supply apparatus as hereinbefore defined for a moisture maintenance system associated with, say, a refrigerated display cabinet, storeroom or other refrigerated area containing, for example, fresh food products, said apparatus comprising a source of water, such as a water reservoir, means for generating airborne moisture from the water source, and means arranged to mix or otherwise combine a bacteriacidal level of ozone, preferably from an ozone generator, directly with the so-generated airborne moisture.

Combining or mixing of the ozone with the generated airborne moisture is preferably carried out downstream, but preferably immediately downstream or adjacent and more preferably immediately adjacent, the water source (reservoir).

As indicated above, such direct mixing or otherwise combining of the ozone and airborne moisture provides more efficient absorption/adsorption of the ozone in/on the water droplets of the airborne moisture and, thus, a more efficient and effective method of killing any bacteria therein.

In order that the invention may be more fully understood, a preferred embodiment of moisture supply apparatus in accordance therewith will now be described by way of example and with reference to the accompanying drawings in which:

Figure 1 is a diagrammatic representation of a moisture supply apparatus in association with a fresh food product display cabinet; and

Figure 2 is a side elevational view of an ozone

generator incorporated into the apparatus shown in Figure 1.

Referring firstly to Figure 1 of the drawings, apparatus for supplying moisture in the form of a fog to the interior of a refrigerated display cabinet containing fresh food products (not shown) and indicated generally at 20, comprises the following components:

an air intake 1 which either extracts ambient air from the atmosphere exterior of the apparatus and cabinet 20 or receives cold air recirculated from the cabinet;

ducting 2,3 for passing the intake air to a source of moisture, namely, a fog generator 4, where the air is mixed with ultrasonically-generated fog in the form of droplets of water; and

ducting 5 for passing the so-generated moisture/air (fog) mixture to a distribution tube 6 located within the interior of the refrigerated display cabinet and having nozzles 7, ports or other suitable outlets spaced along the length thereof for delivering the fog into the refrigerated cabinet interior.

These components represent generally a known form of moisture supply apparatus for use with a refrigerated display cabinet.

In accordance with the first aspect of the invention, however, the apparatus further comprises an additional component in the form of a source of ozone,

namely, an ozone generator 9 located within a housing 10 of the apparatus through which intake air ducting 11 passes. This ducting 11 connects the ducting 2 and 3 together.

At the fog generator 4, ozone, at a bacteriacidal level, is combined with the water droplets immediately adjacent the level of the reservoir (not shown) of water from which the fog is generated.

Figure 2 shows, on a larger scale and in more detail, the housing 10 and the components contained therein. Accordingly, an air inlet 12 connected to the air intake ducting 2, is provided at one (right hand) end of the housing 10. Air entering the inlet 12 then passes through a filter 13 comprising a first coarse mesh (WELDMESH) 14, a plurality of fine filter elements 15 and a second coarse mesh (WELDMESH) 16. This filter 13 removes coarser particles, such as dust, dirt and any other comparatively large foreign bodies from the air.

A baffle 17 is provided in an upper region of the housing 10 just downstream of the filter 13, so that all the air passes into the ducting 11 at a lower region of the housing 10. The ducting 11 has an enlarged cross-section 18 extending over substantially the whole of the cross-section of the housing 9 and communicating with an air outlet 19 via a fan 21. The air outlet 19 is connected, in turn to the ducting 3 communicating with the fog generator 4.

In an upper region of the housing 10, above the ducting 11, is provided the ozone generator ~~9 of known~~ construction, which has an angled outlet 22 in its

lower wall communicating with the ducting 11. Associated with the ozone outlet 22 is a fan (not shown) for delivering ozone from the generator 9 with the air flowing through the ducting 9.

In Figure 2, intake air flowing through the ducting 11 from the inlet 12 via the filter is represented by the single-headed arrows, ozone entering the ducting 11 from the outlet 22 of the ozone generator 9 is represented by the double-headed arrows and the resulting mixture of air and ozone flowing through the ducting 11 and outlet 19 into the ducting 3 (not shown in Figure 2) via the fan 21 is represented by the triple-headed arrows.

In "normal", non-bacteriacidal operation of the inventive moisture supply apparatus of the present embodiment with the ozone generator 9 inoperative, cold air recirculated from the interior of the product display cabinet 20 is drawn into the intake 1 and through the ducting 2,11 and 3 to the fog generator 4. Here, fog is generated by ultrasonically agitating the reservoir of water to produce droplets of water which are then mixed with the air passing through the generator 4. The so-generated fog is then passed through the ducting 5 (Figure 1) and into the fog distribution tube 6 for subsequent delivery to the interior of the refrigerated display cabinet 20 via the nozzles 7 or other suitable outlets, to counteract the drying effect of the refrigeration upon the fresh food products displayed in the cabinet 20, as discussed in detail above.

This "normal", ~~non-bacteriacidal operation~~ of the moisture supply apparatus is such that any bacteria

either already present within the components of the apparatus or entering the apparatus via the air intake 1, can multiply, thus contaminating the apparatus and, subsequently, the interior of the display cabinet 20 and eventually the fresh food products displayed therein.

In "bacteriacidal" operation of the apparatus, and also in accordance with the first inventive method, the ozone generator 9 is operated to inject ozone into the air flowing through the ducting 11 in the housing 10. This mixture of air and ozone then flows through substantially the whole of the interior of the components of the apparatus, namely, those components downstream of the outlet 22 of the ozone generator 9 which include, inter alia, the ducting 3, the fog generator 4, the ducting 5, the distribution tube 6 and the delivery nozzles 7.

As indicated above and in accordance with the third and fourth aspects of the invention, the ozone in the air/ozone mixture can be combined with the fog immediately adjacent the level of the water reservoir in the fog generator 4 from which the fog is generated ultrasonically, so that the apparatus operates in its so-called "atmospheric" mode with both the ozone and fog generators 9, 4 operative.

In this manner, the bacteriacidal ozone in the airborne moisture kills any bacteria present in the water droplets thereof and, to a certain extent, the atmospheric air within the apparatus components, and, thus, to a certain extent on the interior surfaces thereof with which the air/ozone comes into contact.

"Bacteriacidal" operation of the apparatus, namely, when the ozone generator 9 is operative, can be carried out intermittently or substantially continuously, depending upon the required operating conditions at any particular time, and with or without the fog generator 4 operative (atmospheric mode) or inoperative (purging or deep cleansing mode).

In the purging or deep cleansing mode of operation of the apparatus with the fog generator 4 inoperative, the ozone generator 9 may be operated continuously or intermittently for periods of time sufficient to provide a bacteriacidal ozone level of 1.5 to 2.5 parts per million in air within the interior of the components of the apparatus. This provides the so-called "deep cleansing" or "purging" of at least the interior surfaces of the apparatus components with bacteriacidal levels of ozone. Within a period of, say, approximately 15 minutes after the ozone generator 9 has been rendered inoperative, it has been found that the ozone levels within the apparatus components return to a near ambient, generally non-bacteriacidal level of 0.1 parts per million in air, ambient level being of the order of 0.05 parts per million in air. Also, it is preferable to operate the ozone generator 9 such that the ozone level within the interior of the associated display cabinet 20 is no more than 0.2 parts per million in air and that the ozone level adjacent the exterior surfaces of the cabinet is no more than 0.1 parts per million in air, namely, near ambient level of 0.05 parts per million in air, in order to comply with health and safety regulations referenced above.

As indicated above, the ozone generator 9 may be operated whilst the fog generator 4 is either operative (atmospheric mode) or inoperative (purging or deep cleansing mode). However, it has been found that in the former case (atmospheric mode), the bacteriacidal kill rate on the surfaces of the ducting of the apparatus is less, usually far less, than that in the latter case (purging or deep cleansing mode). It is thought that the reason for this phenomenon is that a major proportion of the ozone is adsorbed and/or absorbed by the water droplets in the fog, such that the amount of ozone available for killing bacteria on the interior surfaces of the components of the apparatus is reduced greatly. However, the kill rate of bacteria in the water droplets of the fog is greatly increased.

Thus, to kill bacteria within the ducting rather than within the fog water droplets it is preferred to operate the apparatus in its purging or deep cleansing mode with the ozone generator 9 operative and the fog generator 4 inoperative for periods of time of, say, 2 hours, but in appropriate cases overnight, outside normal trading or working hours, during which a person may otherwise be exposed to ozone levels greater than those specified by health and safety regulations. As indicated above, this provides a "deep cleanse" or "purge" of the apparatus components.

Optionally, the apparatus may be operated in its atmospheric mode continuously or intermittently with both the ozone generator 9 the fog generator 4 operative, possibly during normal trading or working hours, so that the ozone carried ~~by the~~ fog, by absorption by and/or adsorption on the water droplets

thereof, carries out its bacteriacidal function upon the water droplets in the fog, whilst also being delivered in acceptable quantities to the interior of the associated display cabinet 20, so as to have little or no bacteriacidal or other effect on the food products on display in the cabinet.

If, during atmospheric operation of the apparatus, the fog generator 4 is rendered inoperative during, say, normal working hours for defrosting of the associated display cabinet 20 or when the humidity level within the cabinet 20 is at a required level and the fog generator is switched off automatically by operation of, say, a humidistat monitoring the humidity level within the cabinet, then the ozone generator 9 can also be rendered inoperative, to prevent the apparatus operating in its deep cleansing or purging mode to prevent excessive and unacceptable ozone levels within the apparatus and the interior of the display cabinet 20.

Tests carried out over several hours during purging or deep cleansing operational modes of the apparatus, are set forth as follows:

The ozone generator was assessed during operation with the fog generator inoperative, within ducting and other components of the apparatus and within the refrigerated fresh food display cabinet, with regard to the following aspects:

1) The effect on the background bacterial loading of the ducting and the refrigerated display cabinet.

2) The effect on various bacteria and other

organisms placed in the ducting and the display cabinet.

The tests were carried out under the following parameters:

	DUCTING	CABINET
OZONE PPM IN AIR	2.0 - 2.2	0.5
TEMPERATURE °C	20.5	1.5
HUMIDITY %	80	-

1) <u>The effect on the background bacterial loading of the ducting and the refrigerated display cabinet</u>.

Air and contact plate samples were taken in the ducting and the display cabinet both before and after the operation of the ozone generator.

2) <u>The effect on organisms placed in a Petri dish in the ducting and in the refrigerated display cabinet</u>.

Liquid cultures were prepared of Salmonella poona and, *Legionella pneumopila* bacteria, *Aspergillus niger* spores and *Candida albicans* fungus. 0.1 ml of each culture was placed into a Petri dish and spread to give small droplets of liquid culture representing the conditions likely to be found within the ducting and cabinet. The cultures were then placed in either the ducting or the cabinet. The Petri dishes were removed after 30 min, 1 hour and 2 hours. A second series of Petri dishes was placed in the ducting and cabinet after the first hour of operation for 1 hour to see if a decrease in humidity affected the kill rate. Agar

was added to the Petri dish samples with were then incubated and colonies counted.

TABLE 1 Effect on the background bacterial loading of the ducting and the refrigerated display cabinet.

ENVIRONMENTAL PLATE	BEFORE EXPOSURE TO OZONE	AFTER EXPOSURE TO OZONE	% KILL
DUCTING AIR	59	16	72.9
DUCTING SURFACE	38	0	100
CABINET AIR	87	9	89.7
CABINET SURFACE	42	25	40.5

TABLE 2 The effect on bacteria and other organisms placed in a Petri dish in the refrigerated display cabinet.

TIME	*Salmonella poona*	*Legionella pneumophila*	*Aspergillus niger*	*Candida albicans*
0 hrs	440	592	67	256
30 mins	304	520	57	200
1 hr	248	360	50	191
1 hr(2nd)	242	400	69	168
2 hrs	220	216	53	140
% Kill after 2h	50	63.5	20.9	45.3

TABLE 3 The effect on bacteria and other organisms placed in a petri dish in the ducting.

TIME	*Salmonella poona*	*Legionella pneumophila*	*Aspergillus niger*	*Candida albicans*
0 hrs	440	592	67	256
30 mins	184	236	44	42
1 hr	50	140	49	42
1 hr(2nd)	92	51	60	20
2 hrs	3	36	44	18
% Kill after 2h	99.3	94.0	34.3	93.0

The results in Table 1 show a significant reduction in the background bacterial loading of the air and surfaces tested. The bacterial quality of the air passing through the ducting and into the display cabinet was also greatly improved. The surface of the cabinet, where the ozone level was the lowest, showed the least improvement.

The results in Table 2 show a reduction in the number of organisms placed in the display cabinet of approximately 45%. This level of reduction should not have a drastic effect on the bacterial loading of products within the cabinet.

The results in Table 3 show a considerable reduction in numbers of all the organisms placed in the ducting except *Aspergillus niger* spores which did appear to be more resistant to ozone treatment.

These results show that the introduction of ozone at these levels has an anti-microbial (bacteriacidal) effect on the organisms tested and the background microbial loading within the ducting and, to a lesser extent, in the cabinet.

Thus, it can be seen that the inventive moisture supply apparatus and associated method, when operating in its purging or deep cleansing mode with the fog generator inoperative, provides high kill rates for any bacteria and/or other contaminants, such as spores and fungi, present upon the interior surfaces of the components of the apparatus. However, the high levels of ozone used would need to be monitored carefully and the purging and deep cleansing process preferably only carried out at specific times, such as, at night, to minimise any possible health risks.

Further tests carried out over several hours during atmospheric operational modes of the apparatus, namely with both the ozone and fog generators operative, are set forth below:

The ozone generator was assessed during operation

with the fog generator operative, again within ducting and other components of the apparatus and within the refrigerated fresh food display cabinet with regard to the following aspects:

1. The effect on the background bacterial loading of the ducting and the refrigerated display cabinet.

2. The effect on various bacteria and other organisms placed in the ducting and the display cabinet.

TABLE 4 Effect on the background bacterial loading of the ducting and the refrigerated food cabinet.

ENVIRONMENTAL PLATE	BEFORE EXPOSURE TO OZONE	AFTER EXPOSURE TO OZONE	% KILL
DUCTING AIR	20	19	5
DUCTING SURFACE	30	42	0
CABINET AIR	46	29	37
CABINET SURFACE	27	38	0

TABLE 5 The effect on bacteria and other organisms, placed on agar in a Petri dish, in the refrigerated food cabinet.

TIME	*Salmonella poona*	*Legionella pneumophila*	*Aspergillus niger*	*Candida albicans*
0 hours	10^4	10^2	10^4	10_4
30 minutes	10^4	10^2	10^4	10^4
1 hour	10^4	10^2	10^4	10^4
1hour(2nd)	10^4	10^2	10^4	10^4
2 hours	10^4	10^2	10^4	10^4
% Kill after 2hrs	0	0	0	0

TABLE 6 The effect on bacteria and other organisms, placed on agar in a Petri dish, in the ducting.

TIME	*Salmonella poona*	*Legionella pneumophila*	*Aspergillus niger*	*Candida albicans*
0 hours	10^4	10^2	10^4	10^4
30 minutes	10^4	10^2	10^4	10^4
1 hour	10^4	10^2	10^4	10^4
1hour(2nd)	10^4	10^2	10^4	10^4
2 hours	10^4	10^2	10^4	10^4
% Kill after 2 hr	0	0	0	0

All counts in the above Tables are expressed in colony forming units.

Although the kill rates for bacteria and other organisms present on the surfaces of the ducting and in the refrigerated food cabinet were found to be zero, substantial kill rates were found to be effective in respect of bacteria absorbed and/or

adsorbed by the water droplets of the fog, and, to a certain extent, in respect of any airborne bacteria in the air in the atmosphere within the ducting of the apparatus and within the refrigerated display cabinet.

In accordance with the health and safety regulations referred to above, the occupational exposure level for ozone <u>in air</u> must not be greater than 0.2 parts per million averaged over 15 minutes. Thus, when the apparatus is in its atmospheric operational mode, namely with both the ozone and moisture generators (sources) operative, the level of ozone generated by the ozone generator (source) may well exceed the ozone level stipulated by those regulations. However, when the so-generated ozone comes into contact with the moisture from the moisture generator (source), a large proportion thereof is absorbed and/or absorbed by the water droplets of the airborne moisture, resulting in a greatly reduced ozone level in the residual air in the atmosphere within the interior of the apparatus components and/or in the atmosphere within the interior of the refrigerated display cabinet, which reduced ozone level in the air may well be less than the occupational ozone exposure level stipulated by the above-referenced health and safety regulations.

It is to be appreciated that the embodiment of apparatus described in detail above in relation to Figures 1 and 2 of the drawings, can be modified without departing from the basic concept of the invention defined above. For example, the fog generator could be replaced by any other suitable form of moisture source, such as, a humidifier. Indeed, the inventive apparatus can be associated with any

other form of refrigerated area, for example, refrigerated storage. Thus, the invention also provides a moisture maintenance system comprising a refrigerated area in combination with moisture supply apparatus as defined in accordance with the first aspect of the invention.

CLAIMS

1. Moisture supply apparatus as hereinbefore defined, further comprising a source of ozone and means arranged to subject substantially the whole of the interior of the components of the apparatus to ozone at a bacteriacidal level from the ozone source.

2. Apparatus according to claim 1, wherein the source of ozone comprises a port(s) provided in ducting and/or other component(s) of the apparatus and is connected or connectable to a remote ozone generator or an ozone generator otherwise exterior of the ducting and/or other components of the apparatus.

3. Apparatus according to claim 1, wherein the source of ozone comprises an ozone generator incorporated with other components of the apparatus.

4. Apparatus according to claim 1, 2 or 3, wherein the source of ozone is upstream of the source of moisture.

5. Apparatus according to any preceding claim including means arranged to mix or otherwise combine ozone from the source thereof with moisture from the source of moisture directly downstream thereof.

6. Apparatus according to claim 5, wherein said means for mixing or otherwise combining ozone with the moisture is immediately downstream of the source of moisture.

7. Apparatus according to claim 5 or 6, wherein said means for mixing or otherwise combining ozone with the

moisture is adjacent, preferably immediately adjacent, the source of moisture.

8. Apparatus according to claim 7, wherein said means for mixing or otherwise combining ozone with the moisture is adjacent, preferably immediately adjacent, a reservoir of water of the moisture source from which moisture can be generated.

9. Apparatus according to any preceding claim, wherein the source of ozone is operable continuously or intermittently.

10. Apparatus according to claim 9, wherein the ozone source is operable intermittently for predetermined periods of time.

11. Apparatus according to any preceding claim, wherein the ozone source is operable simultaneously with the operation of the moisture source.

12. Apparatus according to any of claims 1 to 10, wherein the ozone source is operable with the moisture source inoperative.

13. Apparatus according to any preceding claim, wherein the source of moisture comprises a fog generator.

14. Apparatus according to any preceding claim, wherein the ozone source is arranged to maintain within substantially the whole of the interior of the components of the apparatus a bacteriacidal ozone level for a period of time sufficient to kill substantially all, but at least a major proportion of,

the bacteria in those components.

15. Apparatus according to claim 14, wherein said bacteriacidal ozone level is 1.5 to 2.5 parts per million in air, preferably no more than 2.0 parts per million in air.

16. Apparatus according to any preceding claim, wherein said ozone-subjecting means comprises a fan.

17. A method of bacteriacidally treating moisture supply apparatus as hereinbefore defined, comprising subjecting substantially the whole of the interior of the components of the apparatus to a bacteriacidal level of ozone.

18. A method according to claim 17, wherein the bacteriacidal ozone is introduced into the apparatus via a port(s) which is provided in ducting and/or other component(s) of the apparatus and is/are connected or connectable to an ozone generator remote from or otherwise exterior of the apparatus.

19. A method according to claim 17, wherein the ozone is provided from an ozone generator incorporated with the other components of the apparatus.

20. A method according to claim 17, 18 or 19, wherein the ozone is introduced into or generated in the apparatus, as the case may be, upstream of the source of moisture of the apparatus.

21. A method according to claim 20, wh rein the bacteriacidal ozone is mixed or otherwise combined with moisture from the moisture source, downstream

thereof.

22. A method according to claim 21, wherein the ozone is mixed or otherwise combined with the moisture immediately downstream of the moisture source.

23. A method according to any of claims 17 to 22, wherein the ozone source is operated continuously or intermittently.

24. A method according to claim 23, wherein the ozone source is operated intermittently for predetermined periods of time.

25. A method according to any of claims 17 to 24, wherein the ozone source is operated simultaneously with operation of a moisture source.

26. A method according to any of claims 17 to 25, wherein the ozone source is operated with the moisture source inoperable.

27. A method according to any of claims 17 to 25, wherein substantially the whole of the interior of the components of the apparatus is subjected to a bacteriacidal level of ozone for a period of time sufficient to kill substantially all, but at least a major proportion of, the bacteria in those components.

28. A method according to claim 27, wherein said bactericidal ozone level is 1.5 to 2.5 parts per million in air, preferably no more than 2.0 parts per million in air.

29. A method according to any of claims 17 to 28,

wherein the moisture source is provided by a fog generator.

30. A method of bacteriacidally treating airborne moisture, comprising mixing or otherwise combining at a bacteriacidal level of ozone directly with the airborne moisture.

31. A method according to claim 30, wherein the airborne moisture is generated from a reservoir of water and the ozone is mixed or otherwise combined with the so-generated airborne moisture downstream of the water reservoir.

32. A method according to claim 31, wherein the ozone is mixed or otherwise combined with the so-generated airborne moisture immediately downstream of the water reservoir.

33. Apparatus for generating bacteriacidally-treated airborne moisture, comprising a reservoir of water, means for generating airborne moisture from the water reservoir, and means arranged to mix or otherwise combine ozone at a bacteriacidal level directly with the so-generated airborne moisture.

34. Apparatus according to claim 33, wherein said ozone mixing/combining means is located downstream, preferably immediately downstream, of the water reservoir for generating the airborne moisture.

35. Moisture supply apparatus substantially as hereinbefore described with reference to the accompanying drawings.

36. A moisture maintenance system comprising, in combination, a refrigerated area and moisture supply apparatus according to any of claims 1 to 16 and 35.

37. A system according to claim 36, wherein the refrigerated area is a product display cabinet.

38. In combination, moisture supply apparatus according to any of claims 1 to 16 and apparatus for generating bacteriacidally-treated airborne moisture according to claim 33 or 34.